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Rubidium isotopic compositions of angrites controlled by extensive evaporation and partial recondensation

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The depletion in moderately volatile elements (MVE) in solar system materials relative to the bulk solar composition is well-established, but the mechanism behind this depletion is still a matter of debate. Understanding this process is critical to reconstruct the early evolution of the solar system. Rubidium with a 50% condensation temperature (Tc50) of 800 K is a moderately volatile element, like K, Cu and Zn, and its stable isotopes show promises for elucidating the mechanisms of volatile depletion in the inner Solar System.

Angrite meteorites are the most volatile-depleted samples of planetesimal known, and are thus invaluable for studying the MVE depletion. However, the extremely low Rb content presents a major challenge for analyzing their Rb isotopic compositions. We overcame this issue by using a Nu sapphire MC-ICP-MS coupled with an Apex Omega, which allows for the highest sensitivity ever achieved (500 V/ppm for ^{85}Rb) enabling us to measure low-Rb content samples including angrites. Using this method, seven geostandards return Rb isotopic data consistent with previous works. We previously measured a large set of terrestrial MORBs samples (n=16) and Hekla volcanic rocks (n=21) to better establish the Earth's composition (δ^{87}Rb=-0.13 ± 0.06‰, 2SD) [1]. Here we report Rb isotopic data of a set of angrites. Unlike lunar rocks exhibiting heavy Rb isotopic signature compared with the Earth, and the heavy isotopic enrichment previously observed in Eucrites, which are best explained by volatile depletion via evaporation, we find that angrite meteorites present light Rb isotopic compositions. This is similar to the light K isotopic signature previously observed in angrites [2]. Coupled with K isotope, the light Rb isotopic enrichment in angrites support the hypothesis that the angrites parent body experienced extensive evaporation, leading to the loss of most of its Rb, followed by partial kinetic recondensation enriched in the light Rb isotope. This observation further supports the importance of evaporation and condensation on the composition of planetesimals.

[1] Wang et al. (submitted) GCA.

[2] Hu et al. (2022), Nature Communications 13(1), 7669.